PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Eva KONTSEKOVA

Serial No.: 10/521,140

Filed: October 31, 2005

For: TRUNCATED TAU PROTEINS

Confirmation No.: 5448

Examiner: Chernyshev, Olga N.

Group Art Unit: 1633

Atty. Dkt. No.: SONN:065US

FILIPCIK DECLARATION UNDER 37 C.F.R. § 1.132

I, PETER FILIPCIK, declare that:

1. I am an employee of Axon Neuroscience, the assignee of the above-referenced patent application. A copy of my Curriculum Vitae is attached.

2. It is my understanding that the Examiner in charge of the above-captioned application has advanced an enablement rejection against claims 33-34. I am supplying this declaration to provide additional evidence of the enablement of the present claims.

3. This declaration provides evidence that we are able to produce transgenic animals with predictable phenotype using gene constructs described in the present application. In our studies we have clearly shown that the phenotype induced by the transgenes, which are truncated tau, is robust, highly reproducible and predictable.

4. So far we have generated several independent transgenic lines (Tg line #318, Tg line #72 and Tg line #24) using DNA gene constructs encoding proteins, which have shown

neurofibrillary (NF) pathology producing activity when expressed in brain cells. The transgene construct used in the generation of transgenic rat lines #318 and #72 encodes a truncated tau protein of amino acids 93-333 based on the numbering for the four-repeat containing tau 43 isoform. Amino acids 93-333 correspond to nucleotides 279-999. The normal tau 43 protein is 383 amino acids. Thus, as described in the present patent application for the type IIA and IIB tau molecules, the truncated tau protein expressed in rat line #318 and #72 has at least the first 68 N-terminal amino acids and at least the last 40 C-terminal amino acids of the four-repeat tau 43 truncated.

5. The transgene construct used in the generation of transgenic rat line #24 encodes amino acids 93-302, which correspond to nucleotides 277-906, based on the numbering used for isoform 44 (3-repeat tau). The normal tau 44 protein is 352 amino acids. Thus, as described in the present patent application for the type IIA and IIB tau molecules, the truncated tau protein expressed in rat line #24 has at least the first 68 N-terminal amino acids and at least the last 20 C-terminal amino acids of the three-repeat tau 44 truncated.

6. The phenotype of these independent transgenic animals is very similar. The progress of sensory-motor impairment of animals from transgenic line #318 and transgenic line #24 is almost identical. The onset and progression of neurodegeneration is the same in all three transgenic rat lines. The only difference we have observed is in the strength of the resulting phenotype when comparing Tg line #72 and Tg line #24. While behavioral features are almost the same, the life span of those animals containing 4 repeat tau (e.g. Tg line #72) is much shorter when compared to those animals containing 3 repeat tau region (e.g. Tg line #24) of human tau protein. However

we are aware that the aggressiveness of neurodegeneration in human tauopathies including Alzheimer's disease may also be different in different patients.

7. Transgenic rat lines #318 and #24 exhibit neurofibrillary (NF) pathology. Transgenic rat line #24 developed neurofibrillary lesions in the brain stem, spinal cord, primary motor cortex, and hippocampus. Attached Figure 1 shows the staining of neurofibrillary lesions in the hippocampus and cortex of transgenic rat line #24 in the late stage of the disease.

8. Neurological examinations showed similar features in both the #24 and #318 transgenic rat lines. Sensory-motor impairment was measured by the "NeuroScale" method. NeuroScale represents a multi-test battery intended for the quantitative neurobehavioral evaluation of transgenic rats suffering from progressive sensorimotor neurodegeneration. Testing protocol enables complex sensorimotor, neuromuscular, and neurological assessment of rats at different age periods. Complex neurobehavioral characterization of rats involves basic observational assessment, examination of neurological functions and evaluation of rat neuromuscular functions by prehensile traction test, assessing forelimb muscle strength and assessment of sensorimotor coordination abilities using a beam walking test. This experimental strategy can reveal impairment, which could otherwise be hidden, and permits observation of changes caused by chronic neurodegenerative process. As shown in attached Figure 2, the progress of sensory-motor impairment of animals from transgenic line #318 and transgenic line #24 was almost identical. The onset and progression of neurodegeneration was the same in both transgenic rat lines. The transgene was transmitted to subsequent offspring generations and the phenotype remained unchanged even in the 4th generation of offspring.

9. Another measure of cognitive impairment is the object recognition test (ORT). ORT is used to measure object recognition memory, which is the ability to discriminate between objects that have been previously encountered and those that have not been. A spontaneous exploratory activity can be used for measurement of memory function in rats. ORT in animals is based on the natural preference of investigating a novel object rather than a familiar object. The intensity of memory storage can be tested using various types of delays between the first (presentation) and second (challenge) trial, in which the new object replaces a familiar object. As shown in attached Figure 3, transgenic rats from line #24 suffer from early cognitive impairment in the object recognition test.

10. According to our latest data we have concluded that the final neurofibrillary tangle (NFT) load in the terminal stage of life of transgenic animal lines, which were produced using different truncated tau gene constructs, is independent of human tau expression levels as shown in Figure 4. We have quantified those mAb AT8-immunoreactive tangle bearing neurons that display characteristic fibrillary structures in the neuronal cytoplasma. (A) Representative pathological structures present in the reticular formation of the brain stems of transgenic rats stained by mAb AT8 are depicted: perinuclear tangles, intracellular tangles that fill the neuronal soma and neurofibrillary tangles distributed in the somatodendritic compartment (Scale bar = 10 μm). (B) Total number of neurons and neurofibrillary tangles were determined in male rats from the SHR72 (7.5 months old) and SHR318 (10.5 months old) transgenic lines. (C) The final NFT loads in SHR72 and SHR318 male rats showed no significant difference ($P = 0.71$). Bars represent mean values for each group ± SEM.

11. Figure 5 shows that truncated tau transgenic expression in two different lines does not cause neuronal loss in the brainstem and hippocampus of transgenic animals. (A) Stereological analysis of neuronal loss in GRN in 7.5-month old transgenic SHR72 males and 10.5-month-old SHR318 males did not reveal any difference in total neuron numbers in comparison with age-matched wild-type rats (t-test: SHR72 vs wt, $P > 0.05$; SHR318 vs wt, $P > 0.05$). (B) Age related neuronal loss was present in GRN in the SHR rat strain. 7.5-month-old wild type SHR rat males display on average 25.4% fewer Nissl-stained neurons (Bonferroni's post hoc test, $P<0.01$) and 10.5-month-old animals on average 39.7% fewer Nissl-stained neurons (Bonferroni's post hoc test, $P<0.001$) than 5-month-old animals. Bars represent mean values for each group ± SEM. (C) Cresyl violet staining of hippocampal pyramidal neurons (CA 1 area) in the transgenic and control rats did not show any visible differences (Scale bar = 50 μm). (D) Stereological analysis of the total number of pyramidal cells in the hippocampal area CA 1-3 revealed no statistically significant differences between transgenic and wild type rat males in either of the investigated groups (t-test: SHR72 vs wt, $P > 0.05$; SHR318 vs wt, $P > 0.05$).

12. Another striking feature of animals produced by transgenic truncated tau expression is that the observed phenotype is not dependent on genetic background. After the transfer of the transgene from the genetic background of the hypertensive SHR strain into the normotensive Wistar strain (WKY) we have observed, in this new genetic environment, almost the identical phenotype at the level of biochemical examination as well as in behavioral measurements. Although we expected less aggressive neurodegeneration in WKY animals, this was not the case. To illustrate this phenomenon see data included in Figure 6, showing that neurobehavioral impairment of the WKY transgene #72 goes in parallel with that of SHR transgene #72 as demonstrated by an almost identical increase in the neuroscale score. Figure 7 shows no

significant influence of the strain differences on phospho-tau level in CSF at the biochemical level.

13. The resulting phenotype was synergistic in those animals that we have generated by crossing animals encompassing human truncated tau with 4 and 3 repeat. As shown in Figure 8, sensorimotor functions measured by beam walking test were significantly more impaired in transgenic line SHR24/72 (expressing both 3R and 4R truncated tau proteins) when compared with transgenic lines SHR24 (expressing 3R truncated tau) and SHR72 (expressing 4R truncated tau). To further demonstrate the synergistic effect of 3R and 4R truncated tau we performed neuroscale evaluation and we found that the complete neurobehavioral phenotype was significantly more impaired in transgenic line SHR24/72 (expressing both 3R and 4R truncated tau proteins) when compared with transgenic lines SHR24 (expressing 3R truncated tau) and SHR72 (expressing 4R truncated tau) as shown in Figure 9.

14. Neurofibrillary pathology is the most important and earliest immunohistochemical finding in Alzheimer's disease. Thus, an animal model that exhibits neurofibrillary pathology is a useful model of Alzheimer's disease. Among the published animal models our transgenic model belongs to those with the most aggressive neurodegenerative phenotype moreover resembling fundamental neuropathological features of brain typical for Alzheimer's disease sufferers. Furthermore, all the transgenic lines we have generated exert stable phenotype even after several years of continual breeding.

15. I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Peter Filipcik

PETER FILIPCIK

Date: 6. JUNE 2008

CURICULUM VITAE

NAME: RNDr. Peter Filipcik, PhD

BORN: June 26, 1962

CITIZENSHIP: Slovakia

ADDRESS: Podhaj 3, Lamac, 84103 Bratislava,

e-mail: peter.filipcik@savba.sk

EDUCATION:

June 1995 PhD	Slovak Academy of Sciences, Bratislava, Slovakia
June 1986 RNDr.	Comenius University, Faculty of Natural Sciences in Bratislava, Slovakia

EMPLOYMENT:

1996 – pres	Senior scientist - Institute of Neuroimmunology, Slovak Academy of Sciences, Bratislava, Slovakia (part time)
2001 – pres	Senior scientist - Axon Neuroscience GmbH, Vienna, Austria
1986 - 1996	Research assistant, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovakia
2000 - 2001	University of Vienna, Vienna, Austria
1998 - 2000	Visiting scientist at the CCRI, St. Anna Children Hospital, Vienna, Austria
1995 - 1996	Research associate, Dept. of Pharmacol., University of Minnesota, Minneapolis, USA
1993 - 1994	Research assistant, Dept. of Chem. Pharmacol., University of Tokyo, Japan

INTERNATIONAL COURSES AND MEETINGS ATTENDED (selection):

1990	"3rd European Congress on Cell Biology", Florence, Italy
1993	"The Radioisotopes in Biological Research", The Univ. of Tokyo, Tokyo, Japan
1993	"5th Inter-Department Meeting on Chemical Pharmacol.", Seoul, South Korea
1998	"6th Int. Conf. on Alzheimer's Disease and Related Disorders, Amsterdam, Netherlands
2001	"Ageing and Dementia - Current and future concepts", Graz, Austria
2003	In Vitro Human Cell Systems Enabling Drug Discovery , London, UK
2004	"9th International Conference on Alzheimers Disease and Related Disorders", Philadelphia, Pennsylvania
2005	Molecular Medicine Triconference, CHI, San Francisco, California, USA
2006	"10th International Conference on Alzheimers Disease", Madrid, Spain

MEMBERSHIP OF LEARNED SOCIETIES:

1997	Slovak Immunological Society
1996	The Slovak Alzheimer Society
2005	The Slovak Neuroscience Society

PUBLICATION ACTIVITY:

Author and co-author of 21 scientific papers, 2 patents

Bratislava 6. 12. 2006

List of publications:

Filipcik P, Cente M, Ferencik M, Hulin I, Novak M. The role of oxidative stress in the pathogenesis of Alzheimer's disease. Bratisl Lek Listy. 2006, 107 (9-10), 384-394

Pevalova M, **Filipcik P**, Novak M, Avila J, Iqbal K. Post-translational modifications of tau protein Bratisl Lek Listy 2006; 107 (9-10), 346-353

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*Zilka N, ***Filipcik P**, Koson P, Fialova L, Skrabana R, Zilkova M, Rolkova G, Kontsekova E, Novak M. Truncated tau from sporadic Alzheimer's disease suffices to drive neurofibrillary degeneration in vivo. FEBS Lett. 2006 Jun 26;580(15):3582-8.

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Filipcik P, Strbak V, Brtko J. Thyroid hormone receptor occupancy and biological effects of 3,5,3,-L-triiodothyronine (T3) in GH4C1 rat pituitary tumour cells. Physiol Res. 1998;47(1):41-6.

Wei LN, Lee CH, **Filipcik P**, Chang L. Regulation of the mouse cellular retinoic acid-binding protein-I gene by thyroid hormone and retinoids in transgenic mouse embryos and P19 cells. J Endocrinol. 1997 Oct;155(1):35-46.

Nikodemova M, Weismann P, **Filipcik P**, Mraz P, Greer MA, Strbak V. Both iso- and hyperosmotic ethanol stimulate release of hypothalamic thyrotropin-releasing hormone despite opposite effect on neuron volume. Neuroscience. 1997 Oct;80(4):1263-9.

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Filipcik P, Saito H, Katsuki H. 3,5,3'-L-triiodothyronine promotes survival and axon elongation of embryonic rat septal neurons. Brain Res. 1994 May 30;647(1):148-52.

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*Equal contribution.

NEUROBIOLOGY OF AGING supplement:

Filipcik, P; Pevalova, M; Smrzka, O; Novak, M. Neuronal assay based on developmentally inducible expression of Alzheimer's tau, designed for screening of AD therapeutics. NEUROBIOLOGY OF AGING, JUL 2004, 25. Suppl. 2, S265

Pevalova, M; **Filipcik, P**; Mederlyova, A; Cente, M; Smrzka, O; Novak, M Hyperphosphorylation and oxidative stress as early changes in axon's new AD rat model. NEUROBIOLOGY OF AGING, JUL 2004, 25, Suppl. 2, S264

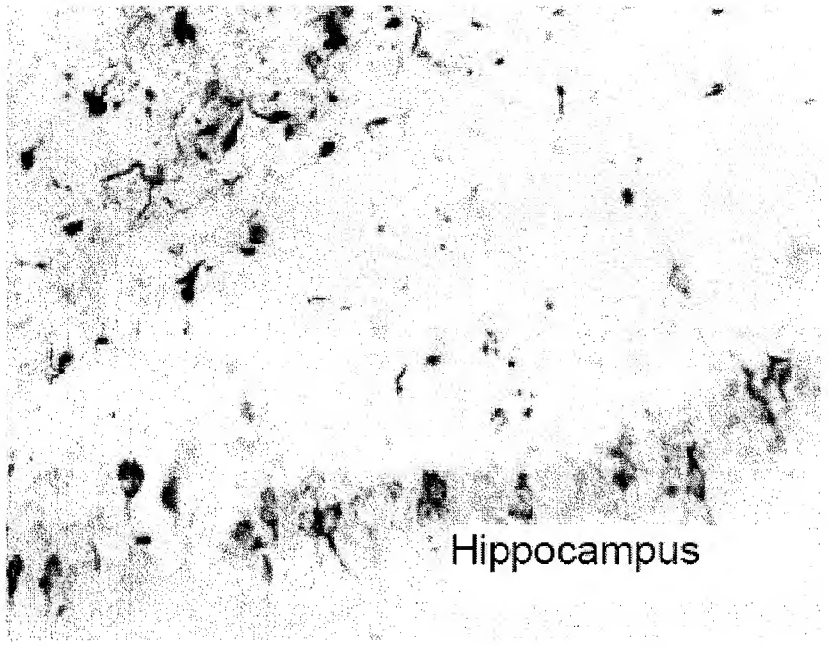
Cente, M; **Filipcik, P**; Hanusovska, E; Zilka, N; Novak, M Onset and intensity of AD changes in transgenic rat expressing Alzheimer specific Tau protein correlates with gene dosage. NEUROBIOLOGY OF AGING, JUL 2004, 25 Suppl. 2, S239

Hrnkova, M; Zilka, N; **Filipcik, P**; Novak, M Cognitive deficit and progressive motor impairment in AD rat model, NEUROBIOLOGY OF AGING, JUL 2004, 25, Suppl. 2, S233

Koson, P; Zilka, N; **Filipcik, P**; Novak, M Neuronal loss in selected brain areas of a new transgenic AD rat model estimated with unbiased stereological methods, NEUROBIOLOGY OF AGING, JUL 2004, 25 Suppl. 2, S249, S250.

Zilka, N; Csokova, N; Vechterova, L; Skrabanova, M; Hrnkova, **M; Filipcik, P**; Novak, M. Staging of neuropathological changes in axon's novel transgenic AD rat model is linked to a lethal phenotype. NEUROBIOLOGY OF AGING, JUL 2004, 25. Suppl. 2, S255

Figure 1



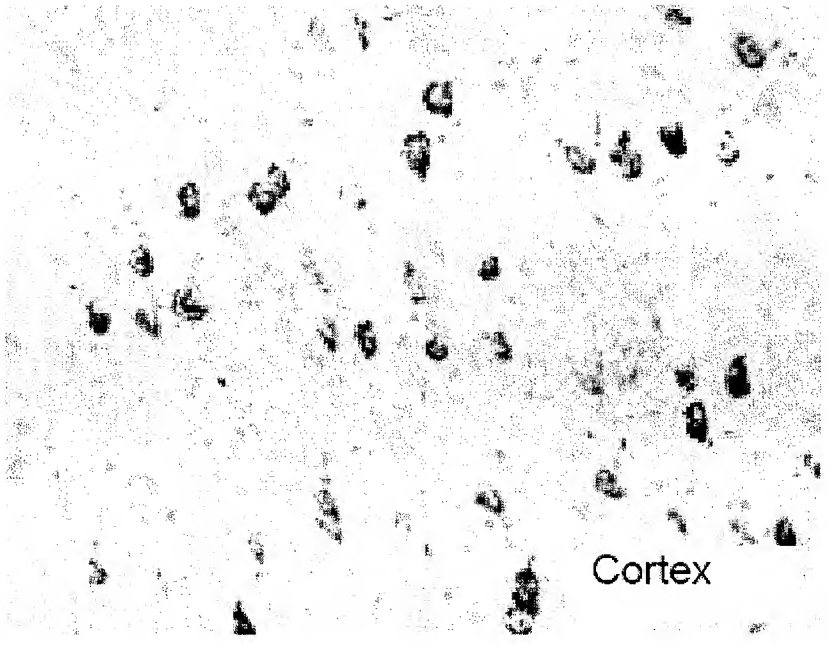
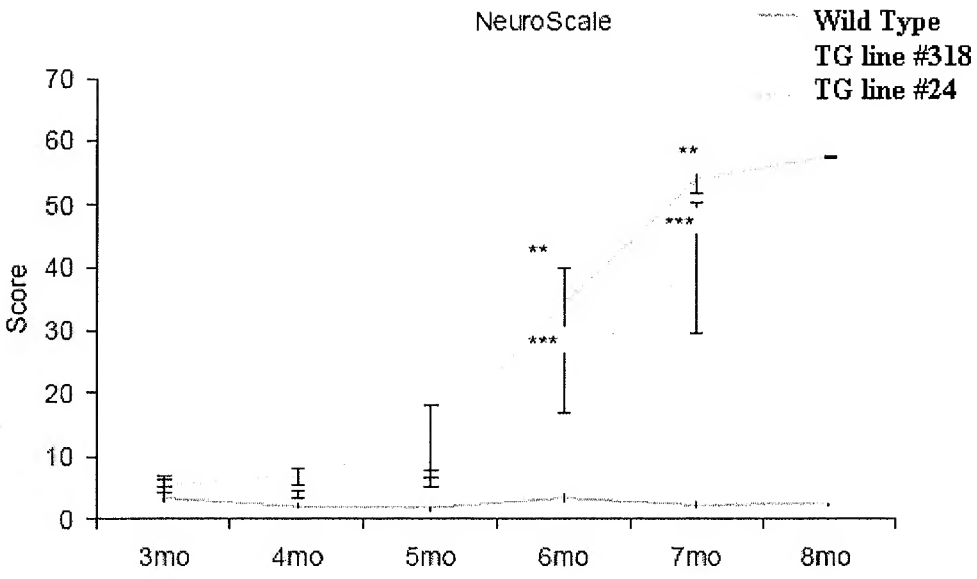


Figure 2


NeuroScale
Wild Type
TG line #318
TG line #24
Score
70
60
50
40
30
20
10
0
3mo
4mo
5mo
6mo
7mo
8mo
**
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**
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Figure 3

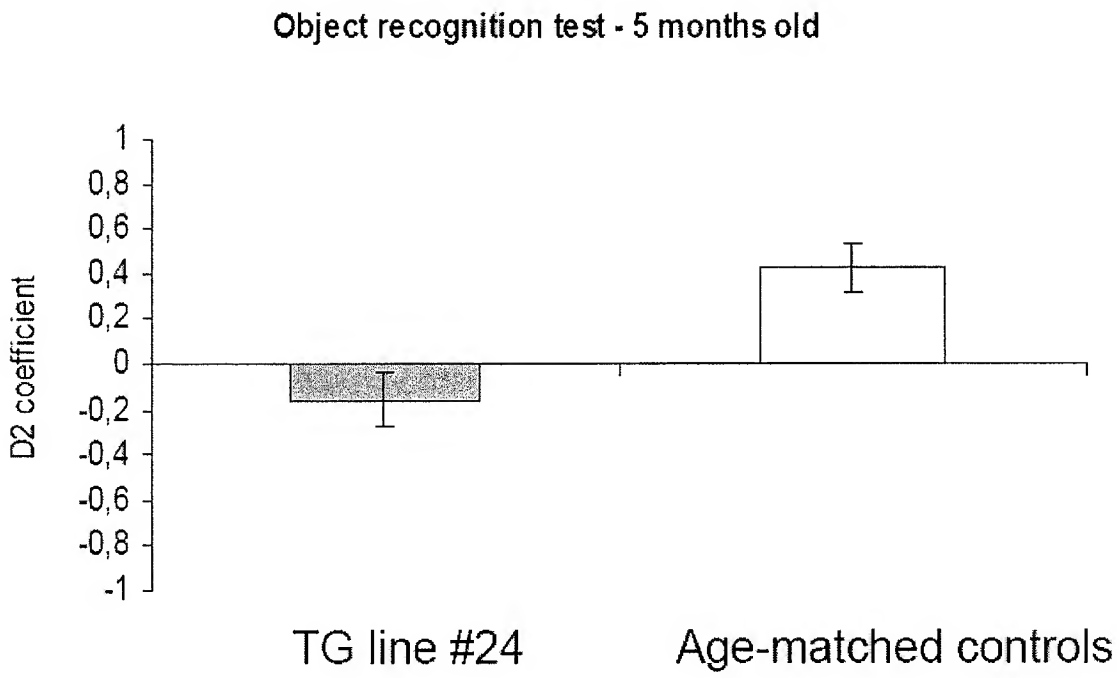

Object recognition test - 5 months old
D2 coefficient
1
0,8
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
-0,8
-1
TG line #24
Age-matched controls

Fig.4

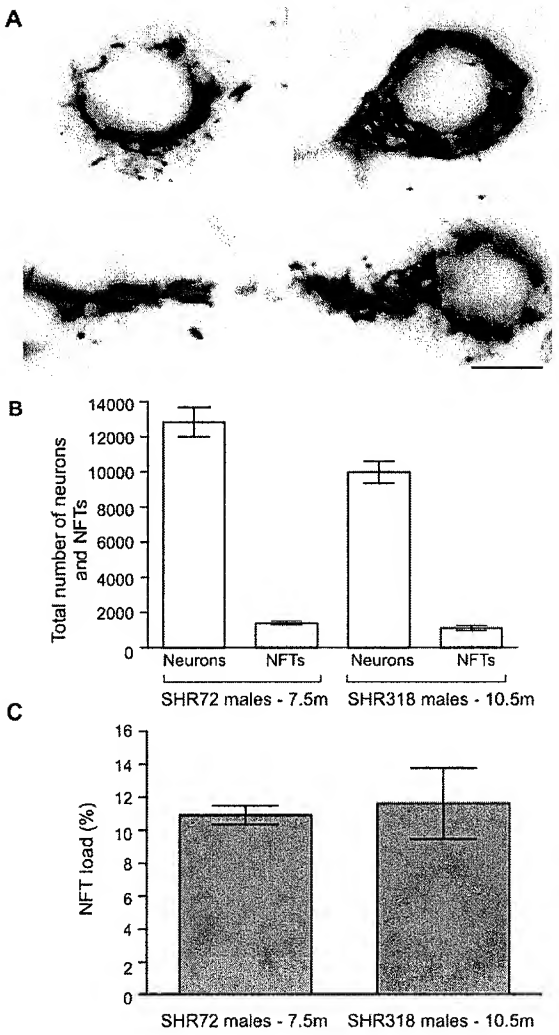

A
B
Total number of neurons and NFTs
14000
12000
10000
8000
6000
4000
2000
0
Neurons
NFTs
Neurons
NFTs
SHR72 males - 7.5m
SHR318 males - 10.5m
C
NFT load (%)
16
14
12
10
8
6
4
2
0
SHR72 males - 7.5m
SHR318 males - 10.5m

Fig. 5

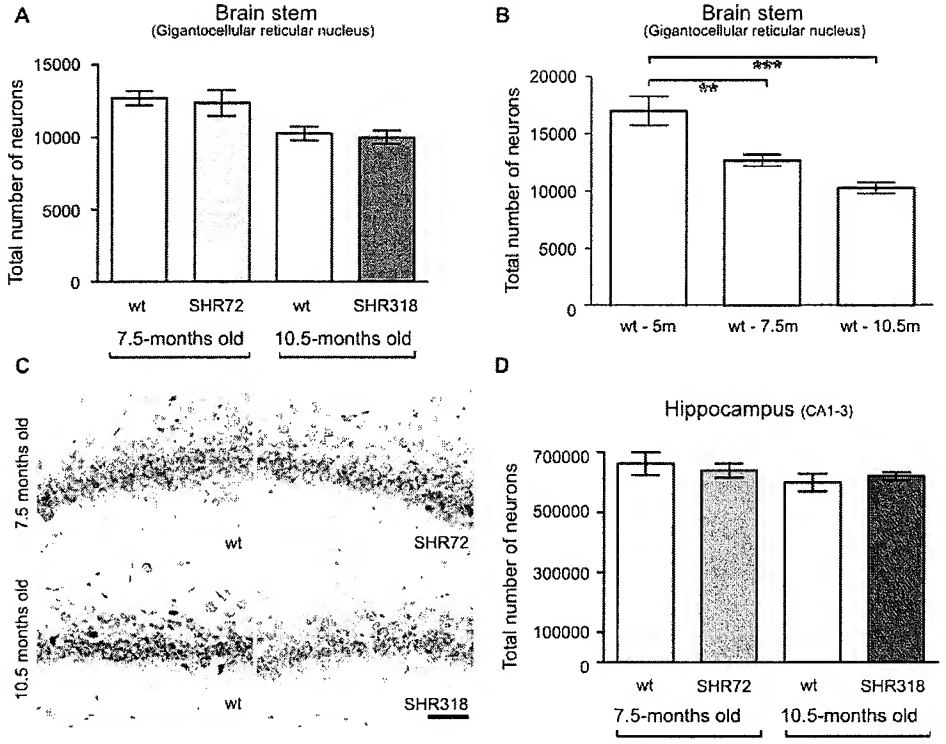

A
Brain stem
(Gigantocellular reticular nucleus)
Total number of neurons
15000
10000
5000
0
wt
SHR72
wt
SHR318
7.5-months old
10.5-months old
B
Brain stem
(Gigantocellular reticular nucleus)
***
**
Total number of neurons
20000
15000
10000
5000
0
wt - 5m
wt - 7.5m
wt - 10.5m
C
7.5 months old
wt
SHR72
10.5 months old
wt
SHR318
D
Hippocampus (CA1-3)
Total number of neurons
700000
500000
300000
100000
0
wt
SHR72
wt
SHR318
7.5-months old
10.5-months old

Fig. 6

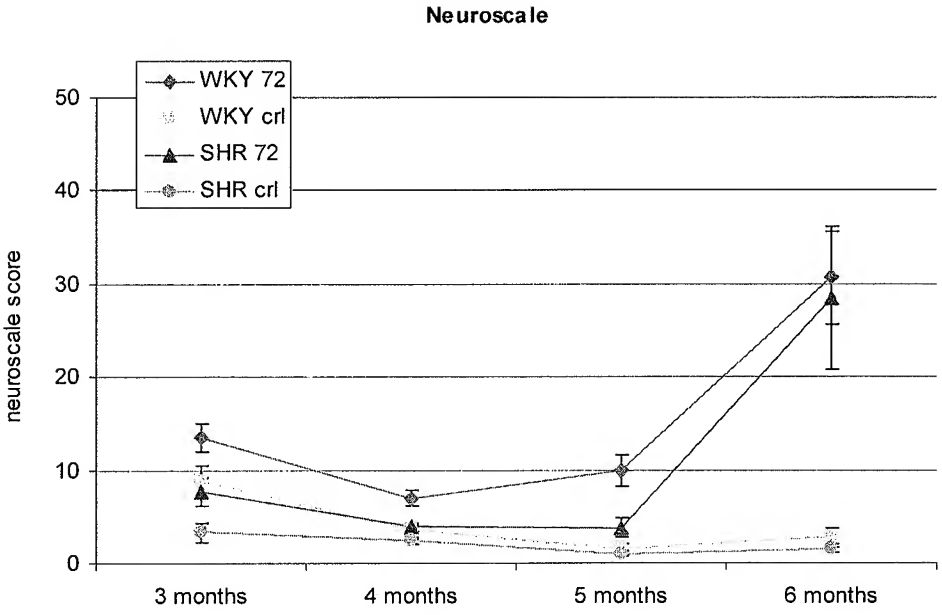

Neuroscale
WKY 72
WKY crl
SHR 72
SHR crl
neuroscale score
50
40
30
20
10
0
3 months
4 months
5 months
6 months

Fig. 7

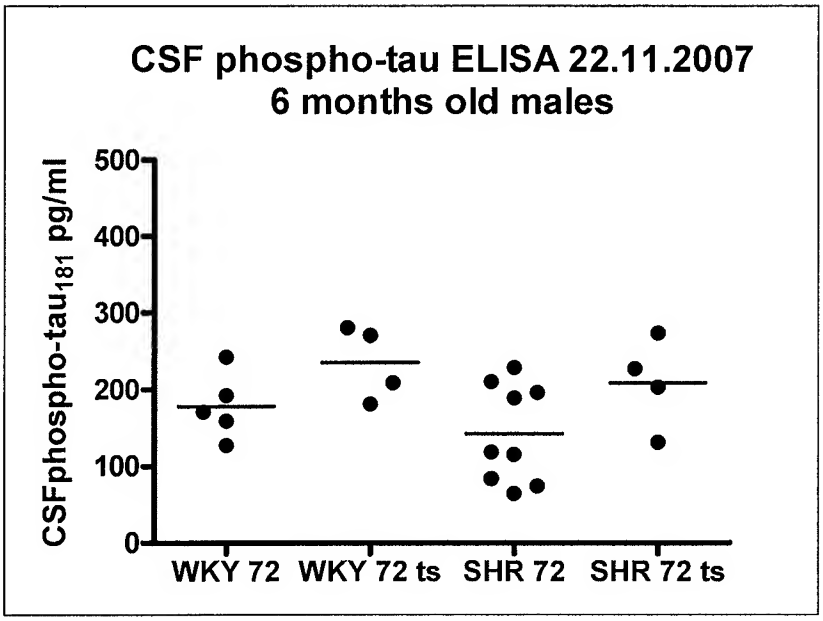
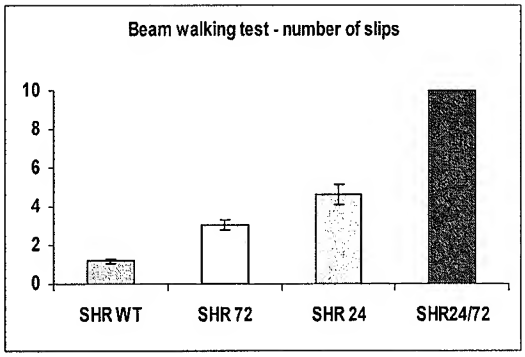

CSF phospho-tau ELISA 22.11.2007
6 months old males
CSFphospho-tau181 pg/ml
500
400
300
200
100
0
WKY 72
WKY 72 ts
SHR 72
SHR 72 ts

Fig. 8.


Beam walking test - number of slips
10
8
6
4
2
0
SHR WT
SHR 72
SHR 24
SHR24/72

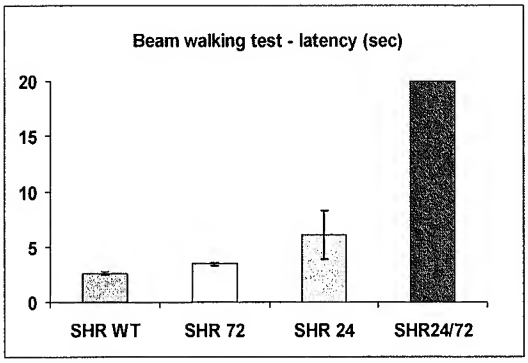
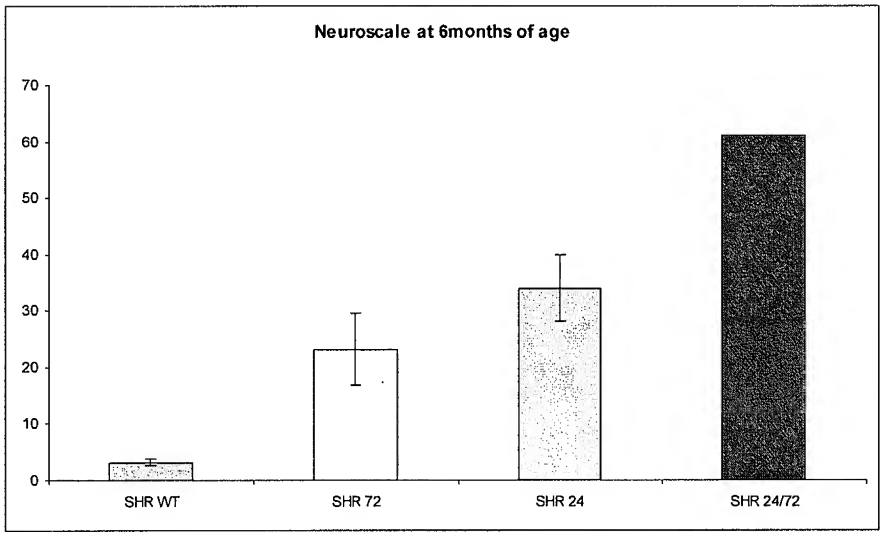

Beam walking test - latency (sec)
20
15
10
5
0
SHR WT
SHR 72
SHR 24
SHR24/72

Fig. 9.


Neuroscale at 6months of age
70
60
50
40
30
20
10
0
SHR WT
SHR 72
SHR 24
SHR 24/72